

## JPL IGS Analysis Center Report, 2001-2003

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### Summary

Three GPS orbit and clock products are currently provided by JPL for consideration by the IGS. Each differs in its latency and quality, with later results being more accurate. Results are typically available in both IGS and GIPSY formats via anonymous ftp. Current performance based on comparisons with the IGS final products is summarized in Table 1. Orbit performance was determined by computing the 3D RMS difference between each JPL product and the IGS final orbits based on 15 minute estimates from the sp3 files. Clock performance was computed as the RMS difference after subtracting a linear trend based on 15 minute estimates from the sp3 files.

**Table 1: Product Quality**

Products	Delivery	Orbit	Clock
Final-Flinn	Weekly	5.2 cm	5.8 cm
Rapid	Daily	7.4 cm	6.2 cm
Real-Time	Every 15 minutes	17.7 cm	14.6 cm

### Recent Improvements

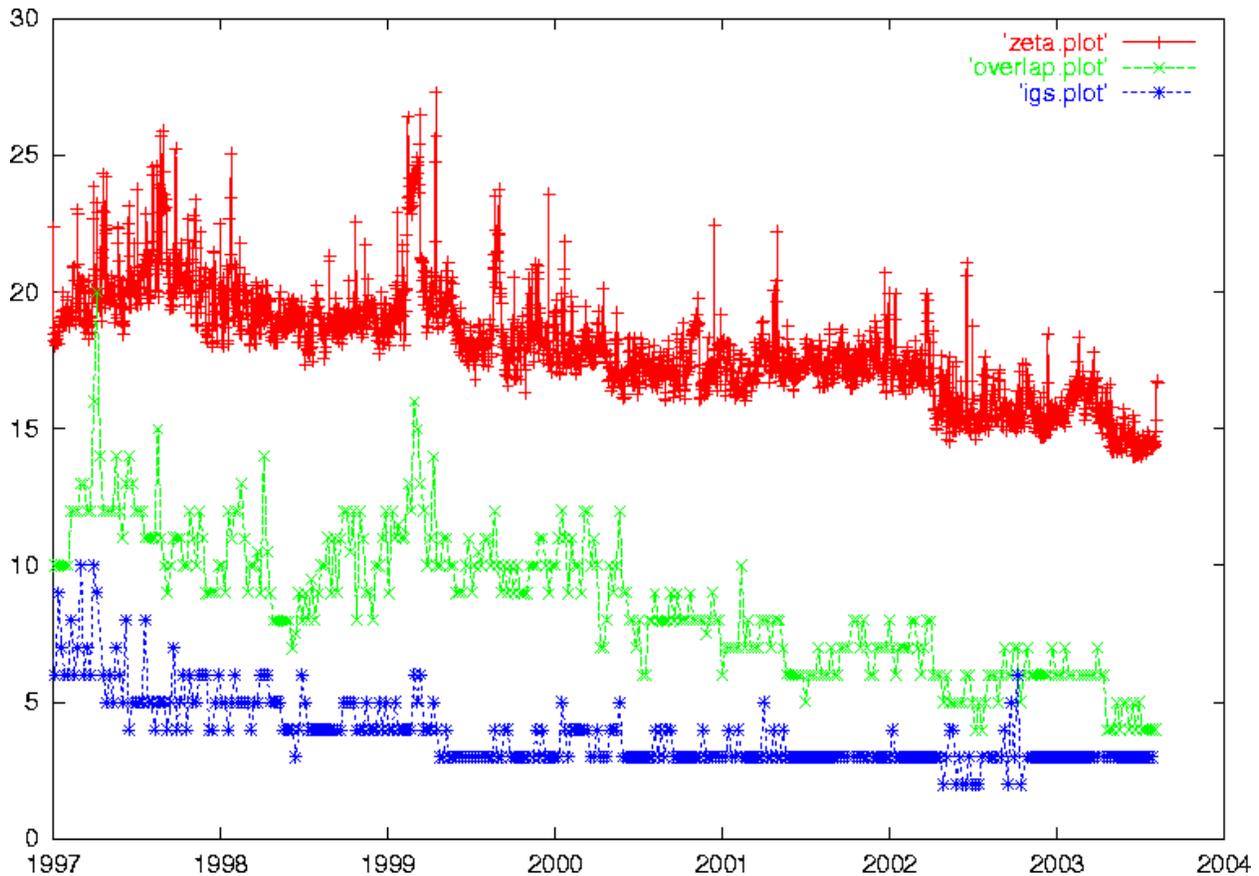
Strategy improvements are listed in Table 2. Preparation for a new GIPSY release resulted in 80 station tracking capability, use of RCS (revision control system) for configuration control, an upgrade to Red Hat 9 (RH9), use of the gcc 3.2.2 compiler, and a new version of qfront. These improvements have led to our longest period of 4-cm orbit overlaps ever as shown in Figure 1.

**Table 2: Strategy Updates**

Action	Date
new qfront which calls clockprep, PvsCA, and teqc	09/14/03
RH9, RCS, gcc 3.2.2	08/10/03
Increase from 60 to 80 sites	04/20/03
Create sp3c files	02/16/03
Extra digit in sp3 files	10/20/02
Use USN1 and AMC2 reference clocks without alignment	09/23/02

**Table 2: Strategy Updates (cont'd)**

Action	Date
Ocean loading upgrade - FES02 [1]	07/23/02
Extra digit in jpl.txt files	07/14/02
New hi-rate clock process	06/17/02
Extra digit in eci files	05/27/02
Increase Flinn tracking network from 42 to 60 sites	04/07/02
Ocean loading upgrade - FES99 [2]	03/03/02
New ITRF2000 nominal coordinate database	01/09/02
Expand Flinn high rate clocks from 27 to 30 hours	01/20/02
ITRF2000 / IGS00 reference frame	12/02/01
IERS2000 tidal models	08/29/01
Tighten edit window to 2 m and 2 cm for range and phase	05/06/01

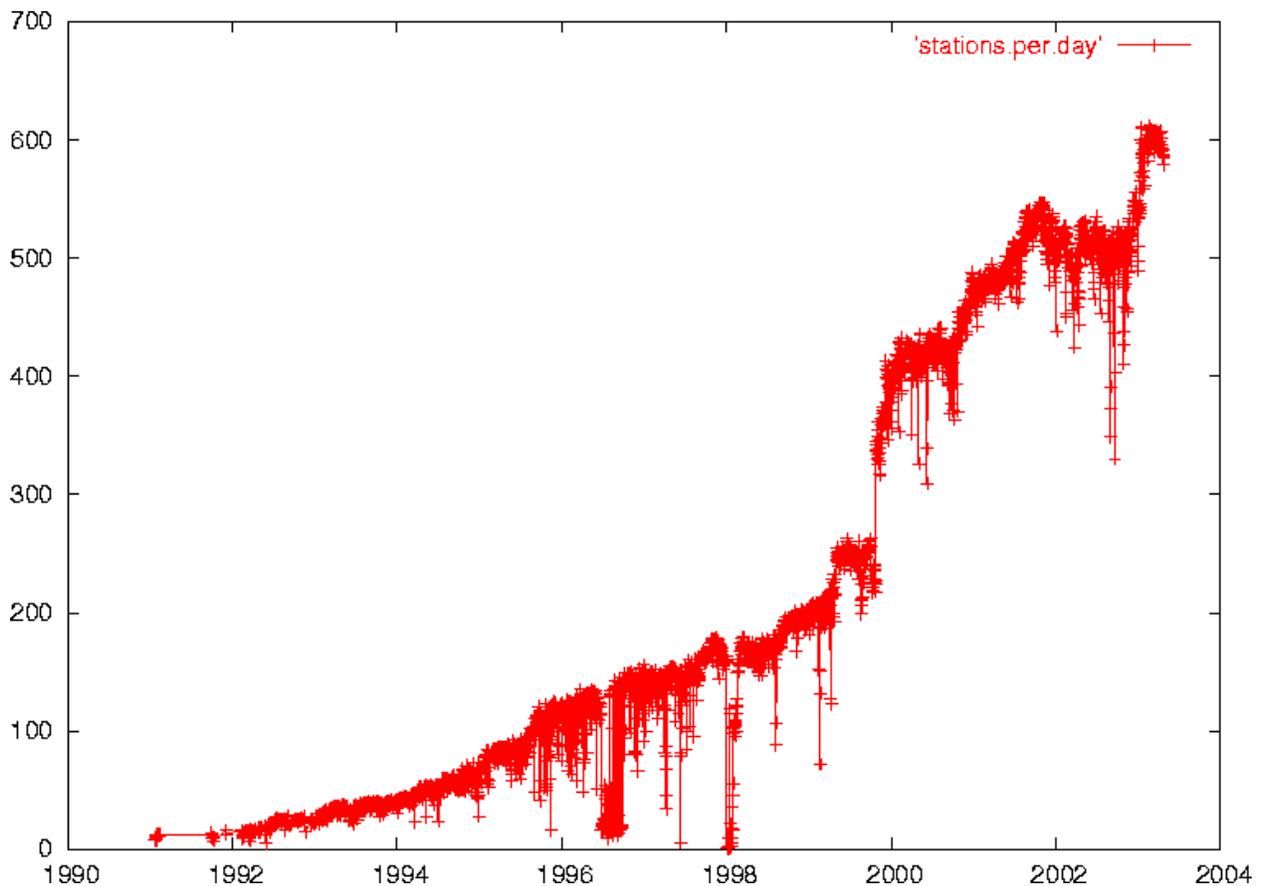


**Figure1: Performance Metrics**

Figure 1 shows the three main metrics used for monitoring performance; (1) zeta in hundreds of km is representative of the site distribution density, (2) three-dimensional orbit overlaps from day to day in cm, and (3) one-dimensional IGS orbit comparisons in cm. All metrics have

improved over time. There is a significant correlation between tracking site distribution and orbit quality.

Flinn orbits and clocks are used in the analysis of data from NASA (and other) flight projects, including the ocean altimetry mission JASON and the gravity mission GRACE. Flinn orbits and clocks are also used to compute point positions for hundreds of terrestrial GPS sites around the world. Figure 2 shows the growth of point positioning over time from roughly 20 sites per day in 1991 to more than 600 sites per day in 2003. JPL currently computes time series for the IGS, SCIGN, CORS, NBAR, and PANGA networks. These time series provide insight into global plate motion, post-glacial rebound, seasonal loading, co- and post-seismic deformation due to earthquakes, and interseismic strain accumulation related to seismic hazards in active boundary zones such as Southern California. The current global velocity field is illustrated in Figure 3.



**Figure 2: Point Positions Per Day**

## Products

Various products are made available via ftp and http as listed in Table 3. There are three major orbit and clock products. Orbit estimates can be found in the IGS format .sp3 and .yaw files as well as in the GIPSY format .eci, .yaw or .yaw\_rates, and .shad or .shadow\_events files. Clock information can be found in the IGS format .clk and .sp3 files and in the GIPSY format .gps\_clock and .tdpc files. Tropospheric estimates can be found in the IGS format .tro files.

Earth orientation information is contained in the IGS format .erp files and the GIPSY format TPNML and tpeo.nml files. Post-processing based on Flinn products is used to derive our final time series of polar motion, length of day, geocenter, scale, and site position [3].

**Table 3: Product Files**

Real-Time Products

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ftp://sideshow.jpl.nasa.gov/pub/gipsy\_products/15min  
jpl12322.clk.Z  
jpl12322.sp3.Z  
jpl12322.tro.Z  
jpl12322.yaw.Z  
2003-08-19.TPNML.Z  
2003-08-19.eci.Z  
2003-08-19.gps\_clocks.Z  
2003-08-19.shadow\_events.Z  
2003-08-19.yaw\_rates.Z

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Rapid Products

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ftp://sideshow.jpl.nasa.gov/pub/gipsy\_products/RapidService/orbits  
jpl12321.clk.Z  
jpl12321.erp  
jpl12321.sp3.Z  
jpl12321.sp3c.Z  
jpl12321\_pred.sp3.Z  
jpl12321\_pred\_pc.sp3.Z  
2003-08-18.DONE  
2003-08-18.PREDICT  
2003-08-18.TPNML.Z  
2003-08-18.TPNML.predict.Z  
2003-08-18.eci.Z  
2003-08-18.eci.predict.Z  
2003-08-18.eci.predict.edited.Z  
2003-08-18.frame  
2003-08-18.gps\_clocks.Z  
2003-08-18.shadow\_events.Z  
2003-08-18.yaw\_rates.Z

**Table 3: Product Files (cont'd)**

## Final-Flinn Products

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[ftp://sideshow.jpl.nasa.gov/pub/gipsy\\_products/jpligsac/1230](ftp://sideshow.jpl.nasa.gov/pub/gipsy_products/jpligsac/1230)  
 jpl12300.clk.Z  
 jpl12300.sp3.Z  
 jpl12300.sp3c.Z  
 jpl12300.tro.Z  
 jpl12300.yaw.Z  
 jpl12307.erp.Z  
 jpl12307.snx.Z  
 jpl12307.sum.Z

[ftp://sideshow.jpl.nasa.gov/pub/gipsy\\_products/2003/orbits](ftp://sideshow.jpl.nasa.gov/pub/gipsy_products/2003/orbits)  
 2003-08-09.eci.Z  
 2003-08-09\_nf.eci.Z  
 2003-08-09.tdpc.Z  
 2003-08-09\_nf.tdpc.Z  
 2003-08-09tpeo.nml.Z  
 2003-08-09tpeo\_nf.nml.Z  
 2003-08-09.frame  
 2003-08-09.shad.Z

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## Time Series

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<http://sideshow.jpl.nasa.gov/mbh/series.html> - web page with links to tables, plots, and ftp areas

<ftp://sideshow.jpl.nasa.gov/pub/mbh/point> - IGS, SCIGN, CORS, NBAR, and PANGA  
<ftp://sideshow.jpl.nasa.gov/pub/mbh/filtered> - ambiguity resolved, regionally filtered SCIGN  
<ftp://sideshow.jpl.nasa.gov/pub/mbh/stacov> - ambiguity resolved SCIGN stacov files

Time series are given as three ASCII files SITE.lat, SITE.lon, and SITE.rad containing the time in years, estimate in cm, sigma in cm, site, component, and date. Stacov files contain X, Y, Z estimates in m, sigmas in m, and correlations.

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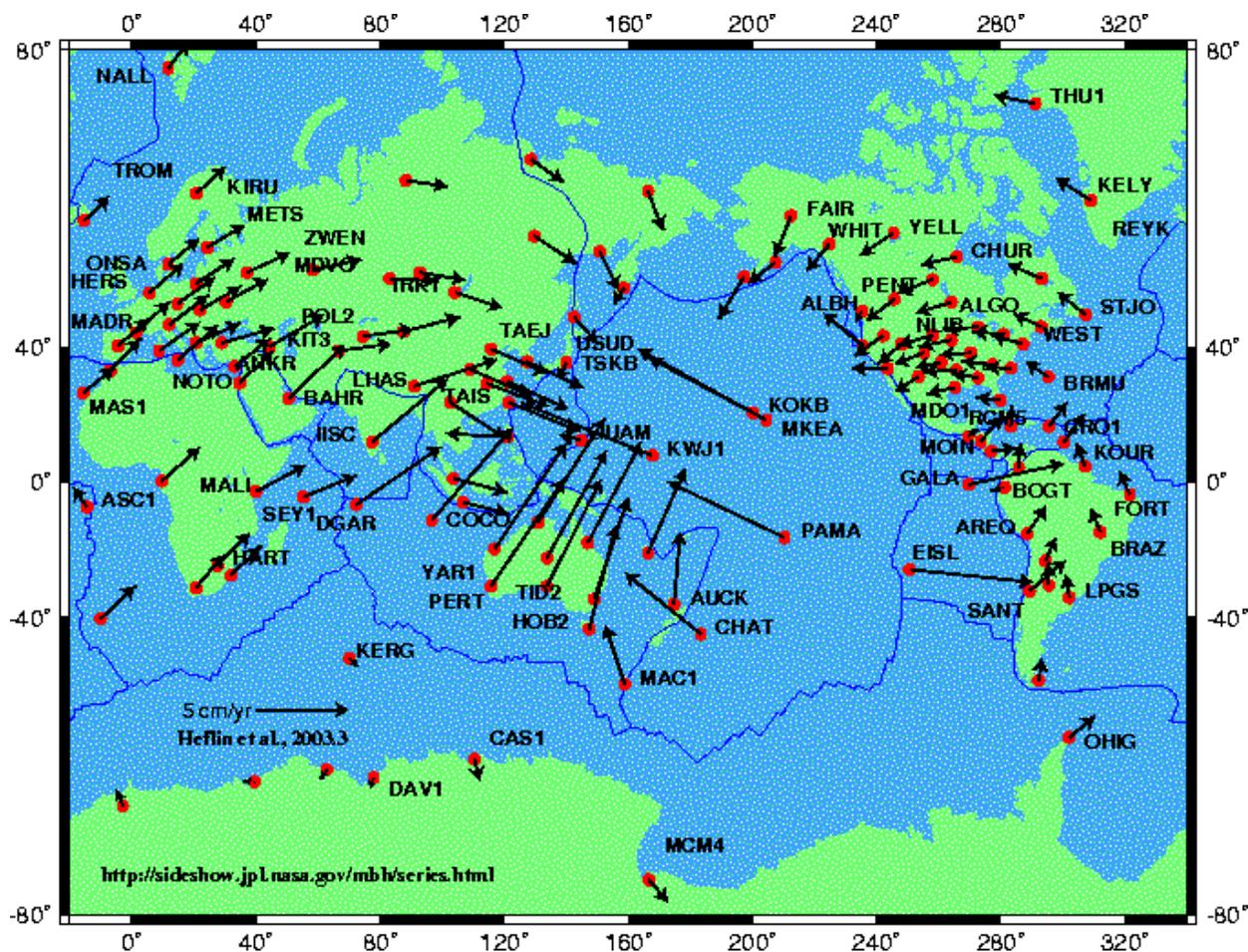


Figure 3: Global GPS Velocity Field

### Acknowledgment

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### References

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Le Provost, C., F. Lyard, F. Lefevre and L. Roblou, *Abstract Volume, Jason-1 Science Working Team Meeting*, Biarritz, France, 2002.

#### A global tide finite element solution assimilating tide gauge and altimetric information, FES99

Lefevre, F., F. Lyard, C. Le Provost, and E. J. O. Schrama, *Journal of atmospheric and oceanic technology*, 19 (9), 1345-1356, 2002.

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